



Original Article

To Study the Effects of Magnesium Sulphate on Haemodynamic Changes During Laparoscopic Cholecystectomies in Patients Attending a Tertiary Care Centre

Dr. Rajagopal. V¹, Dr. Hemlata kamat¹, Dr. Geetika Duggal¹

¹ Department of Anaesthesiology, Pramukhswami Medical College & Shree Krishna Hospital, Karamsad-388325, Gujarat, India.

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Corresponding Author:

Dr. Rajagopal. V

Department of Anaesthesiology,
Pramukhswami Medical College &
Shree Krishna Hospital, Karamsad-
388325, Gujarat, India

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ABSTRACT

Background: Laparoscopic cholecystectomy is associated with significant hemodynamic alterations due to laryngoscopy, endotracheal intubation, and carbon dioxide pneumoperitoneum. These changes are mediated by sympathetic stimulation and catecholamine release and may increase perioperative morbidity. Magnesium sulphate, owing to its calcium-antagonist and sympatholytic properties, has been proposed as an effective agent to attenuate these responses.

Objectives: To evaluate the effect of intravenous magnesium sulphate on hemodynamic parameters during laparoscopic cholecystectomy and to assess its impact on anesthetic requirements and perioperative adverse effects.

Materials and Methods: This prospective comparative observational study was conducted on 40 adult patients (ASA I-II) undergoing elective laparoscopic cholecystectomy. Patients were randomly allocated into two groups: Group M (magnesium sulphate 40 mg/kg loading dose followed by 10 mg/kg/hr infusion) and Group S (normal saline). Hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, end-tidal CO₂, and SpO₂ were recorded at predefined intervals. Requirement of rescue propofol infusion and adverse effects were noted.

Results: Demographic variables and surgical duration were comparable between groups. Group M demonstrated significantly attenuated increases in systolic, diastolic, and mean arterial pressures following pneumoperitoneum compared to Group S (p<0.05). Heart rate trends were lower and more stable in the magnesium group. Propofol infusion was required in 11 patients in the saline group due to hypertensive responses, whereas none in the magnesium group required rescue infusion. End-tidal CO₂ and SpO₂ remained comparable and within physiological limits in both groups. Adverse effects of magnesium sulphate were mild and transient.

Conclusion: Intravenous magnesium sulphate effectively attenuates hemodynamic responses to pneumoperitoneum during laparoscopic cholecystectomy, reduces anesthetic requirements, and is safe when administered in controlled doses.

Keywords: Magnesium sulphate, laparoscopic cholecystectomy, pneumoperitoneum, hemodynamic response, general anesthesia

INTRODUCTION

Laparoscopic cholecystectomy has become the standard surgical approach for gallbladder diseases due to reduced postoperative pain, shorter hospital stay, and early recovery [1]. However, despite its minimally invasive nature, the procedure is associated with significant hemodynamic disturbances caused by laryngoscopy, tracheal intubation, and creation of carbon dioxide pneumoperitoneum [2,3].

Pneumoperitoneum increases intra-abdominal pressure and causes absorption of carbon dioxide, resulting in hypercarbia, increased systemic vascular resistance, and stimulation of the sympathetic nervous system [4]. These physiological changes

manifest as tachycardia, hypertension, and increased myocardial oxygen demand, which may be detrimental in patients with limited cardiovascular reserve [5].

Magnesium has the ability to block the release of catecholamines from both the adrenal gland and the adrenergic nerve terminals. Apart from that, magnesium can produce vasodilatation by acting directly on blood vessels and is also capable of attenuating vasopressin stimulated vasoconstriction. Intravenously administered magnesium sulphate is capable of attenuating the adverse hemodynamic responses associated with endotracheal intubation also. So it has been hypothesized that intravenously administered magnesium sulphate would be efficacious to attenuate the adverse hemodynamic responses in patients undergoing elective laparoscopic cholecystectomy with carbon dioxide pneumoperitoneum [1].

Various pharmacological agents including opioids, beta-blockers, alpha-2 agonists, vasodilators, and intravenous anesthetics have been used to attenuate these responses, but their use is often limited by side effects such as excessive sedation, respiratory depression, and delayed recovery [6–8].

Magnesium sulphate is an attractive alternative due to its ability to inhibit catecholamine release, block calcium channels, and antagonize NMDA receptors [9,10]. These properties contribute to its sympatholytic, vasodilatory, and anesthetic-sparing effects [11]. Several studies have shown that magnesium sulphate reduces the hemodynamic response to intubation and pneumoperitoneum and decreases anesthetic and opioid requirements [12–15].

Despite growing evidence, data on the use of magnesium sulphate during laparoscopic cholecystectomy in Indian tertiary care settings remain limited. Therefore, the present study was designed to evaluate the efficacy and safety of intravenous magnesium sulphate in attenuating hemodynamic changes during laparoscopic cholecystectomy.

MATERIAL AND METHODS

A prospective comparative observational study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital over a period of 18 months after institutional ethical committee approval.

Study Population

Forty adult patients aged 18–60 years, belonging to ASA physical status I and II, scheduled for elective laparoscopic cholecystectomy under general anesthesia were enrolled.

Inclusion Criteria

- Age 18–60 years
- ASA I–II
- Elective laparoscopic cholecystectomy
- Written informed consent

Exclusion Criteria

- Patient refusal
- Severe cardiac or respiratory disease
- Renal impairment
- Known hypersensitivity to magnesium
- Electrolyte imbalance

Group Allocation

Patients were randomly divided into two equal groups (n=20):

- **Group M:** Magnesium sulphate 40 mg/kg diluted to 15 ml, administered over 15 minutes before induction, followed by continuous infusion at 10 mg/kg/hr.
- **Group S:** 15 ml of 0.9% normal saline over 15 minutes, followed by infusion at 0.1 ml/kg/hr.

Anesthetic Technique

All patients received standardized general anesthesia with intravenous induction agents, muscle relaxants, endotracheal intubation, and controlled ventilation. Pneumoperitoneum was maintained with intra-abdominal pressure of 12–14 mmHg.

Data Collection

Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, end-tidal CO₂, and SpO₂ were recorded at baseline, post-intubation, during pneumoperitoneum at regular intervals, and postoperatively. Rescue propofol infusion was initiated if MAP increased by >25% from baseline.

Statistical Analysis

Data were analyzed using statistical software. Continuous variables were expressed as mean ± SD. Intergroup comparisons were performed using appropriate statistical tests. A p-value <0.05 was considered statistically significant.

RESULTS

Both groups were comparable with respect to age, weight, sex distribution, duration of surgery, and duration of pneumoperitoneum, with no statistically significant differences ($p > 0.05$). This ensured baseline homogeneity between the groups.

Heart rate increased following laryngoscopy and pneumoperitoneum in both groups; however, the increase was consistently lower and more stable in the magnesium group throughout the intraoperative period. Although intergroup differences did not reach statistical significance at all time points, the overall trend indicated attenuation of sympathetic response in Group-M.

Systolic, diastolic, and mean arterial pressures showed significant increases in the saline group following pneumoperitoneum, particularly between 15 and 90 minutes. In contrast, Group M demonstrated significantly lower blood pressure values during the same period ($p < 0.05$), indicating better hemodynamic control.

Eleven patients in the saline group developed significant hypertension requiring propofol infusion, whereas none in the magnesium group required rescue anesthetic intervention. End-tidal CO₂ increased progressively after pneumoperitoneum in both groups but remained within physiological limits, with no significant intergroup difference. Oxygen saturation remained at 100% throughout surgery in both groups.

Adverse effects related to magnesium sulphate were minimal and included mild sedation and warmth. No serious complications such as hypotension, respiratory depression, or arrhythmias were observed.

Table 1: Physical Parameters – Age and Weight

Parameter	Group M (Mean ± SD)	Group S (Mean ± SD)	P value	Significance
Age (years)	42.7 ± 10.32	44.6 ± 10.09	0.55	Not Significant
Weight (kg)	57.65 ± 11.61	56.85 ± 5.85	0.78	Not Significant

The mean age in Group M was 42.7 ± 2.31 years and in Group S was 44.6 ± 2.26 years. The mean weight in Group M was 57.65 ± 2.59 kg and in Group S was 56.85 ± 1.31 kg. The difference in mean age and weight between the two groups was not statistically significant.

Table 2: Sex Distribution

Gender	Group M (n)	Group S (n)
Male	8	9
Female	12	11

Table 3: Comparison of Duration of Surgery

Parameter	Group M (Mean ± SD)	Group S (Mean ± SD)	P value	Significance
Duration of surgery (minutes)	107 ± 20.28	110 ± 12.13	0.57	Not Significant

The mean duration of surgery in Group M was 107 ± 4.54 minutes and in Group S was 110 ± 2.71 minutes. The duration of surgery was comparable between both groups, and no statistically significant difference was observed.

Table 4: Comparison of Duration of Pneumoperitoneum

Parameter	Group M (Mean ± SD)	Group S (Mean ± SD)	P value	Significance
Duration of pneumoperitoneum (minutes)	87 ± 20.28	88.5 ± 13.08	0.78	Not Significant

The mean duration of pneumoperitoneum in Group M was 87 ± 4.54 minutes, while in Group S it was 88.5 ± 2.93 minutes. The difference between the two groups was not statistically significant.

Table 5: Changes in Mean Pulse Rate (beats/min) at Different Time Intervals – Comparison Between Groups

Time	Group M Mean ± SD	Group S Mean ± SD	P value	Significance
Baseline	86.15 ± 8.01	83.50 ± 8.46	12.62	NS
Preinduction	93.20 ± 13.35	85.80 ± 12.78	3.25	NS
Laryngoscopy	95.00 ± 13.51	84.70 ± 18.53	2.07	NS
1 min	100.35 ± 12.33	93.85 ± 13.29	4.68	NS
2 min	99.80 ± 12.21	95.30 ± 13.27	10.86	NS
5 min	91.05 ± 11.95	87.70 ± 10.89	14.40	NS
10 min (PP started)	85.30 ± 12.42	86.15 ± 12.04	33.08	NS
15 min	84.60 ± 11.77	86.10 ± 12.29	27.82	NS
20 min	87.45 ± 11.37	87.70 ± 10.12	37.67	NS
25 min	89.35 ± 13.34	89.50 ± 10.83	38.76	NS
30 min	88.50 ± 12.53	92.55 ± 10.25	10.81	NS
35 min	88.55 ± 12.93	95.30 ± 10.55	3.14	NS
40 min	88.20 ± 13.04	96.60 ± 10.19	1.16	NS
45 min	90.05 ± 11.14	96.40 ± 10.48	2.84	NS
50 min	89.65 ± 12.57	97.10 ± 11.23	2.22	NS
55 min	88.75 ± 12.50	98.00 ± 10.66	0.64	NS
60 min	86.90 ± 11.60	98.75 ± 10.36	0.06	NS
70 min	86.78 ± 12.58	98.75 ± 11.83	0.16	NS
80 min	88.22 ± 11.70	96.10 ± 9.96	1.19	NS
90 min	91.22 ± 12.82	96.11 ± 11.27	8.37	NS
100 min	94.68 ± 11.88	99.29 ± 11.60	8.86	NS
110 min	100.16 ± 11.04	101.82 ± 10.67	16.54	NS
120 min	101.14 ± 8.32	106.20 ± 13.05	5.14	NS
130 min	102.00 ± 11.14	93.00 ± 21.21	2.82	NS

Changes in Mean Pulse Rate

Group M:

Baseline pulse rate (PR) was 86.15 ± 1.79 beats/min. Following laryngoscopy, PR increased from 95 ± 3.02 to 100.35 ± 2.76 beats/min at 1 minute (increase of 5.63%). After initiation of pneumoperitoneum (PP), PR gradually increased from 85.3 ± 2.78 to 90.05 ± 2.49 beats/min at 35 minutes (increase of 5.57%). Thereafter, PR remained stable for the next 60 minutes. A

further rise was observed after 90 minutes, reaching 101.14 ± 3.14 beats/min at 110 minutes (increase of 18.57%).

Group S:

Baseline PR was 83.5 ± 1.89 beats/min. Following laryngoscopy, PR increased from 84.7 ± 4.14 to 95.3 ± 2.97 beats/min at 2 minutes (increase of 12.51%). After pneumoperitoneum, PR showed a similar trend, with an increase of 11.9% at 35 minutes. A further increase of 14.62% was observed at 60 minutes (86.15 ± 2.69 to 98.75 ± 2.65 beats/min). PR increased further to 106.2 ± 5.83 beats/min at 120 minutes (increase of 23.04%).

The differences in PR between the groups were not statistically significant throughout the study period ($p > 0.05$).

Table 6: Changes in Mean Systolic Blood Pressure (mm Hg) at Different Time Intervals – Comparison Between Groups

Time	Group M Mean ± SD	Group S Mean ± SD	P value	Significance
Baseline	124.3 ± 14.16	125.3 ± 12.30	32.51	NS
Preinduction	126.7 ± 15.27	123.55 ± 14.07	20.06	NS
Laryngoscopy	118.9 ± 21.20	117.55 ± 21.68	33.72	NS
1 min	133.6 ± 20.49	146.3 ± 17.66	1.70	NS
5 min	115.2 ± 16.03	115.45 ± 14.35	38.35	NS
10 min (PP started)	113.9 ± 15.16	114.65 ± 14.14	34.89	NS
15 min	119.75 ± 14.92	125.35 ± 12.36	8.16	NS
20 min	123.65 ± 13.46	137.95 ± 13.41	0.07	NS
25 min	129.95 ± 11.42	147.20 ± 11.77	0.00	S
30 min	129.65 ± 11.24	149.15 ± 9.55	0.00	S
35 min	129.00 ± 8.29	154.30 ± 11.61	0.00	S
40 min	130.30 ± 11.99	151.30 ± 12.84	0.00	S
45 min	129.80 ± 10.50	147.30 ± 8.99	0.00	S
50 min	129.90 ± 11.34	148.60 ± 8.26	0.00	S
55 min	127.95 ± 11.91	146.30 ± 7.90	0.00	S
60 min	127.20 ± 10.77	146.35 ± 9.65	0.00	S
70 min	128.84 ± 12.36	149.70 ± 10.93	0.00	S
80 min	129.44 ± 10.69	151.40 ± 9.54	0.00	S
90 min	129.83 ± 8.11	148.89 ± 11.23	0.00	S
100 min	132.25 ± 11.73	152.94 ± 11.23	0.00	S
110 min	137.08 ± 13.97	151.10 ± 12.97	0.57	NS
120 min	137.14 ± 16.15	159.00 ± 9.38	0.27	NS
130 min	138.00 ± 7.21	150.00 ± 19.80	1.90	NS

Changes in Mean Systolic Blood Pressure

Group M:

Baseline systolic blood pressure (SBP) was 124.3 ± 3.17 mmHg. Following laryngoscopy, SBP increased from 118.9 ± 4.74 to 133.6 ± 4.58 mmHg at 1 minute (increase of 12.36%). At initiation of pneumoperitoneum, SBP was 113.9 ± 3.39 mmHg. SBP showed a rising trend with a maximum increase at 30 minutes post-PP (130.3 ± 2.68 mmHg; increase of 14.4%). SBP remained stable until 90 minutes, with a marginal rise noted between 110–130 minutes.

Group S:

Baseline SBP was 125.3 ± 2.75 mmHg. Following laryngoscopy, SBP increased from 117.55 ± 4.85 to 146.3 ± 3.95 mmHg at 1 minute (increase of 24.4%). At initiation of PP, SBP was 114.65 ± 3.16 mmHg. Following pneumoperitoneum, SBP continued to rise with a maximum increase of 34.8% at 25 minutes. The SBP was stable thereafter, possibly due to propofol infusion in many patients.

The systolic blood pressure showed a statistically significant increase in Group S compared with Group M from 15 minutes post-PP up to 110 minutes (p = 0.004).

Table 7: Changes in Mean Diastolic Blood Pressure (mm Hg) at Different Time Intervals – Comparison Between Groups

Time	Group M Mean ± SD	Group S Mean ± SD	P value	Significance
Baseline	79.75 ± 7.70	80.60 ± 6.33	28.20	NS
Preinduction	79.05 ± 8.46	78.80 ± 5.67	36.52	NS
Laryngoscopy	75.60 ± 11.45	72.05 ± 9.82	11.97	NS
1 min	84.15 ± 12.12	89.15 ± 7.70	5.11	NS
5 min	74.15 ± 9.99	76.20 ± 8.41	19.48	NS

Time	Group M Mean ± SD	Group S Mean ± SD	P value	Significance
10 min (PP started)	75.35 ± 9.06	74.90 ± 10.52	35.42	NS
15 min	78.85 ± 10.25	79.05 ± 11.83	38.18	NS
20 min	79.30 ± 8.90	84.90 ± 10.38	2.99	NS
25 min	82.30 ± 7.29	92.75 ± 11.32	0.05	NS
30–90 min	—	—	0.00–0.03	S
100–130 min	—	—	>0.05	NS

Changes in Mean Diastolic Blood Pressure

Group M:

Baseline diastolic blood pressure (DBP) was 79.75 ± 1.72 mmHg. Following laryngoscopy, DBP increased to 84.15 ± 2.71 mmHg at 1 minute (increase of 11.31%). At initiation of PP, DBP was 75.35 ± 2.03 mmHg. DBP gradually increased, with a rise of 9.22% at 15 minutes post-PP. DBP remained stable until 100 minutes, when a rise of 14.57% was noted.

Group S:

Baseline DBP was 80.6 ± 1.42 mmHg. Following laryngoscopy, DBP increased from 72.05 ± 2.20 to 89.15 ± 1.72 mmHg at 1 minute (increase of 23.74%). At initiation of PP, DBP was 74.9 ± 2.35 mmHg. DBP increased up to a maximum of 26.7% at 20 minutes post-PP, after which no further rise was observed.

In comparison with Group M, the rise in DBP was statistically significant in Group S from 20 minutes to 90 minutes post-PP ($p = 0.004$).

Table 8: Changes in Mean Arterial Pressure (mm Hg) at Different Time Intervals – Comparison Between Groups

Time	Group M Mean ± SD	Group S Mean ± SD	P value	Significance
Baseline	94.65 ± 9.73	95.40 ± 7.90	31.62	NS
Preinduction	95.20 ± 9.86	94.35 ± 7.09	30.24	NS
Laryngoscopy	90.15 ± 14.61	86.75 ± 13.61	18.00	NS
1 min	100.70 ± 14.24	113.75 ± 28.23	3.37	NS
5 min	87.85 ± 11.56	89.25 ± 9.59	27.16	NS
10 min (PP started)	88.20 ± 10.36	87.95 ± 11.46	37.68	NS
25–100 min	—	—	<0.05	S
110–130 min	—	—	>0.05	NS

CHANGES IN MEAN ARTERIAL PRESSURE (mmHg) AT DIFFERENT TIME INTERVALS-comparison between groups

Changes in Mean Arterial Pressure

Group M:

Baseline mean arterial pressure (MAP) was 94.65 ± 2.18 mmHg. Following laryngoscopy, MAP increased to 100.7 ± 3.19 mmHg at 1 minute (increase of 11.7%). MAP decreased gradually and was 88.2 ± 2.32 mmHg at initiation of PP. MAP then increased, reaching a peak of 98.25 ± 1.61 mmHg at 15 minutes post-PP. MAP remained stable until 100 minutes, with a rise observed between 100–130 minutes.

Group S:

Baseline MAP was 95.4 ± 1.77 mmHg. Following laryngoscopy, MAP increased from 86.75 ± 3.04 to 113.75 ± 6.31 mmHg at 1 minute (increase of 31.12%). At initiation of PP, MAP was 87.95 ± 2.56 mmHg. MAP increased to a maximum of 113.4 ± 1.74 mmHg at 20 minutes post-PP.

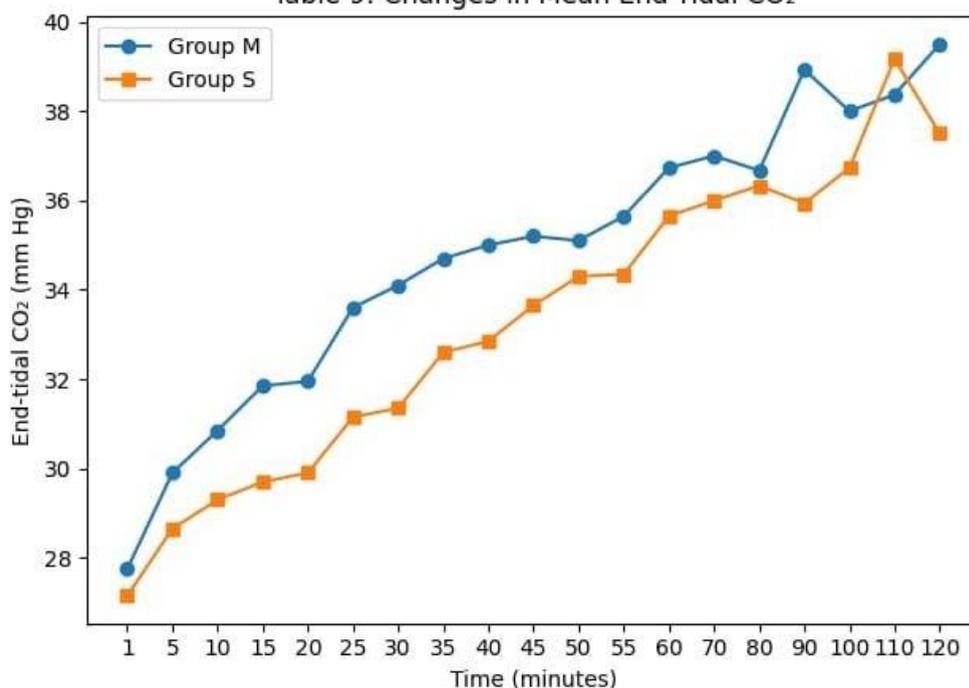
The difference in MAP between the two groups was statistically significant from 15 minutes up to 90 minutes post-PP ($p = 0.004$).

Table 9: Changes in Mean End-Tidal CO₂ (mm Hg) at Different Time Intervals – Comparison Between Groups

Time	Group M Mean \pm SD	Group S Mean \pm SD	P value	Significance
1 min	27.75 ± 2.31	27.15 ± 2.23	16.36	NS
5 min	29.90 ± 4.19	28.65 ± 3.60	12.72	NS
10 min (PP started)	30.85 ± 5.02	29.30 ± 3.77	11.05	NS
15 min	31.85 ± 4.68	29.70 ± 3.18	3.90	NS
20 min	31.95 ± 4.46	29.90 ± 2.69	3.54	NS
25 min	33.60 ± 3.94	31.15 ± 3.03	1.36	NS
30 min	34.10 ± 3.43	31.35 ± 2.64	0.28	NS
35 min	34.70 ± 3.18	32.60 ± 3.12	1.66	NS
40 min	35.00 ± 3.51	32.85 ± 3.44	2.30	NS
45 min	35.20 ± 3.66	33.65 ± 2.81	5.67	NS
50 min	35.10 ± 3.57	34.30 ± 3.81	19.89	NS
55 min	35.65 ± 3.41	34.35 ± 3.62	9.97	NS
60 min	36.73 ± 3.98	35.65 ± 4.02	15.67	NS
70 min	37.00 ± 4.47	36.00 ± 3.09	16.11	NS
80 min	36.67 ± 4.34	36.33 ± 3.03	28.47	NS
90 min	38.93 ± 3.99	35.94 ± 3.23	0.78	NS
100 min	38.00 ± 3.41	36.73 ± 3.72	6.15	NS
110 min	38.37 ± 3.50	39.17 ± 2.04	8.84	NS

Time	Group M Mean ± SD	Group S Mean ± SD	P value	Significance
120 min	39.50 ± 4.65	37.50 ± 2.12	3.65	NS

Table 9: Changes in Mean End-Tidal CO₂



Graph No. 1: Changes in Mean End-Tidal CO₂ (mm Hg) at Different Time Intervals – Comparison Between Groups

Changes in End-Tidal CO₂

Group M:

Baseline end-tidal CO₂ (EtCO₂) at 1 minute post-intubation was 27.75 ± 0.52 mmHg. At the beginning of PP, EtCO₂ was 30.85 ± 1.12 mmHg and showed a progressive increase throughout surgery, reaching a maximum of 39.5 ± 2.33 mmHg at 120 minutes (28% increase).

Group S:

Baseline EtCO₂ was 27.15 ± 0.50 mmHg. At the beginning of PP, it was 29.3 ± 0.84 mmHg. A similar progressive increase was observed, with a maximum value of 39.17 ± 0.83 mmHg at 110 minutes (33.69%). The changes in both groups were similar and not statistically significant (p > 0.05).

Table 10: Changes in Mean SpO₂ (%) at Different Time Intervals – Comparison Between Groups

Time	Group M Mean ± SD	Group S Mean ± SD	P value	Significance
Baseline	99.1 ± 1.12	99.3 ± 1.38	0.62	NS
Preinduction	99.85 ± 0.49	99.75 ± 0.64	0.58	NS
At laryngoscopy	100 ± 0.00	100 ± 0.00	0.33	NS
1–130 min	100 ± 0.00	100 ± 0.00	0.33	NS

Changes in SpO₂

SpO₂ values showed no variation in either group following intubation and remained at 100% throughout the surgery. The changes were not statistically significant (p > 0.05).

Requirement of Propofol Infusion

In the saline group, 11 patients developed a significant increase in mean arterial pressure (>25% from baseline), necessitating the use of propofol infusion. No patient in the magnesium group required rescue propofol.

Table 11: Requirement of Propofol Infusion in Saline Group

Parameter	Number of Cases
Cases requiring propofol infusion	11
Cases not requiring propofol infusion	9

In the saline group 11 patients had a very significant increase (+25% from baseline) in the mean arterial pressure necessitating the use of propofol infusion.

Adverse Effects of Magnesium Sulphate

Intraoperative adverse effects were minimal. Warmth and flushing were observed in 10 patients (50%), and mild sedation in 2 patients (10%). No hypotension, respiratory depression, ECG changes, or cardiac arrest were reported.

Postoperatively, headache occurred in 2 patients (10%), nausea in 1 patient, and mild sedation in 3 patients (15%). No serious adverse events were observed

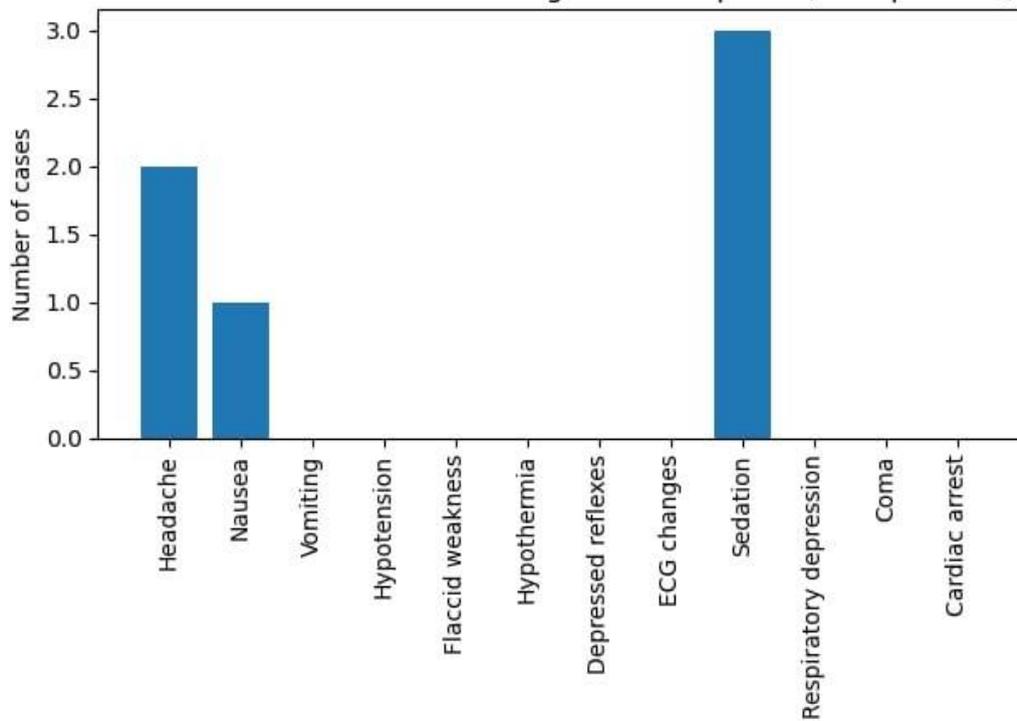
Table 12: Incidence of Adverse Effects and Complications of Magnesium Sulphate

Complication	Frequency	Percentage
Warmth & flushing	10	50%
Headache	0	0%
Nausea	0	0%
Dizziness	0	0%
Hypotension	0	0%
Flaccid weakness	0	0%
Respiratory depression	0	0%
Non-specific ECG changes	0	0%
Sedation	2	10%
Cardiac arrest	0	0%

Table 13: Incidence of Adverse Effects and Complications of Magnesium Sulphate in the Post-Operative Period

Complication	Frequency	Percentage
Headache	2	10%
Nausea	1	5%
Vomiting	0	0%
Hypotension	0	0%
Flaccid weakness	0	0%
Hypothermia	0	0%
Depression of deep tendon reflexes	0	0%
Non-specific ECG changes	0	0%
Sedation	3	15%
Respiratory depression	0	0%
Coma	0	0%
Cardiac arrest	0	0%

Table 13: Adverse Effects of Magnesium Sulphate (Postoperative)



Graph no. 2: Incidence of Adverse Effects and Complications of Magnesium Sulphate in the Post-Operative Period

DISCUSSION

The present study demonstrates that intravenous magnesium sulphate effectively attenuates hemodynamic responses associated with pneumoperitoneum during laparoscopic cholecystectomy. Magnesium's ability to inhibit catecholamine release and reduce calcium-mediated vasoconstriction explains the observed stability in blood pressure and heart rate [9,11].

The significantly lower systolic, diastolic, and mean arterial pressures observed in the magnesium group from 15 to 90 minutes after pneumoperitoneum are consistent with findings reported by Ryu et al. and Jee et al. [13,14]. The reduced requirement for rescue propofol infusion further highlights magnesium's anesthetic-sparing effect.

Heart rate responses were attenuated in the magnesium group, although not statistically significant, which aligns with previous studies demonstrating blunted sympathetic responses with magnesium administration [12,15]. Stable end-tidal CO₂ and SpO₂ values confirm that magnesium does not adversely affect respiratory parameters.

The safety profile of magnesium sulphate observed in this study is consistent with earlier reports showing minimal adverse effects when administered in recommended doses [16–18]. The absence of serious complications supports its routine use as an adjunct in laparoscopic anesthesia.

Overall, magnesium sulphate offers a simple, effective, and economical strategy to improve intraoperative hemodynamic stability during laparoscopic cholecystectomy.

Moreover, magnesium sulphate, being a cheaper and easily available drug compared to other drugs and methods used for blunting the haemodynamic stress response of pneumoperitoneum can be a novel alternative [19].

CONCLUSION

Intravenous magnesium sulphate significantly attenuates hemodynamic responses to pneumoperitoneum during laparoscopic cholecystectomy, reduces anesthetic requirements, and is associated with minimal adverse effects. It is a safe and effective adjunct to general anesthesia.

Limitations of the Study

- Single-center study
- Small sample size

- Long-term postoperative outcomes not evaluated
- Results may not be generalizable to high-risk cardiac patients

Declarations:

Conflicts of interest: There is not any conflict of interest associated with this study

Consent to participate: There is consent to participate.

Consent for publication: There is consent for the publication of this paper.

Authors' contributions: Author equally contributed the work.

REFERENCES

1. Miller RD, et al. *Miller's Anesthesia*. 9th ed. Elsevier; 2020.
2. Morgan GE Jr, et al. *Clinical Anesthesiology*. 6th ed. McGraw-Hill; 2018.
3. Joris JL, et al. Anesthesia for laparoscopic surgery. *Anesthesiology*. 1993;79:137–47.
4. Cunningham AJ, et al. Hemodynamic effects of pneumoperitoneum. *Br J Anaesth*. 1993;70:635–7.
5. McLaughlin JG, et al. Cardiovascular effects of laparoscopy. *Surg Endosc*. 1995;9:121–4.
6. Shribman AJ, et al. Cardiovascular responses to laryngoscopy. *Br J Anaesth*. 1987;59:295–9.
7. Bajwa SJS, et al. Attenuation of stress response. *Anesth Essays Res*. 2014;8:300–5.
8. Gan TJ. Postoperative nausea and vomiting. *Anesth Analg*. 2006;102:1884–98.
9. Altura BM, Altura BT. Magnesium and vascular tone. *Am J Physiol*. 1984;247:H937–46.
10. Koinig H, et al. Magnesium sulfate reduces anesthetic requirements. *Anesth Analg*. 1998;87:206–10.
11. Herroeder S, et al. Magnesium—essentials for anesthesiology. *Anesthesiology*. 2011;114:971–93.
12. Altan A, et al. Magnesium and hemodynamic response. *Eur J Anaesthesiol*. 2005;22:298–303.
13. Ryu JH, et al. Magnesium sulphate in laparoscopic surgery. *Br J Anaesth*. 2009;103:484–9.
14. Jee D, et al. Attenuation of pressor response. *Anesth Analg*. 2009;108:857–61.
15. Kogler J, et al. Magnesium as adjuvant. *Acta Anaesthesiol Scand*. 2001;45:689–94.
16. Herroeder S, et al. Perioperative magnesium therapy. *Anesthesiology*. 2011;114:971–93.
17. Telci L, et al. Magnesium sulfate and anesthetic consumption. *Anesth Analg*. 2002;95:117–22.
18. Dabbagh A, et al. Safety of magnesium sulfate. *Acta Med Iran*. 2010;48:16–20.
19. Samiran Das et al. The effects of magnesium sulphate on haemodynamic stress response to pneumoperitonium in laparoscopic cholecystectomy: a double blinded randomised controlled study. *International Journal of Advances in Medicine* Das S et al. *Int J Adv Med*. 2021 Jul;8(7):872-880.